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The NASA ERTS-A Project
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Number 2, Type I Progress Report

Title of the investigation

Demonstration of the applicability of satellite data to forestry.

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Objective

The objective is to study the correlation between forest characteristics and the grey tones of ERTS imagery, and to determine the applicability of this imagery to forest inventory.

ERTS-pictures studied

1039-09315 and 1039-09322 both consisted of 4 MSS bands, taken August 31, 1972

Frame of the study

The design for collecting material is made in concordance with the requirements given to the national forest inventory in Finland. It is also based on the assumption that double or multiphase sampling is applied. One alternative would be to test double sampling in which the first phase consisted of the satellite pictures and the second one of field work. More feasible approach in Finnish conditions might be that, in which aerial photographs and the satellite pictures are used together as the first phase of the sampling procedure.

Two test sites were taken, 18 x 96 km each, in Finnish Lapland (Fig. 1). The sampling units were first drawn on a transparency and then transferred in photographic way to aerial photographs according to a special square coordination system. The aerial photography was at scale of 1:60000 and the positive prints were rectified to scales 1:60000 or 1:50000. The location of sampling units to the satellite pictures and to field was made from the aerial photographs.

Photo plots

The study areas were divided into tracts of 8 x 8 km and those further into squares of 1 x 1 km (Fig. 2). On the other hand, the study areas were divided into two parts of equal size. On the other part every four square had a cluster of 6 plots 100 metres apart along the line which plots were interpreted from the aerial photos. On the other part, again, every two squares had 3 plots 200 metres apart along the line. Thus, the relative size of samples as measured by the number of sample plots was equal on both parts. The number of plots interpreted from aerial photos was accordingly 4608. The plots were interpreted for all stand characteristics regarded as important, i.e. land use class, subclass, i.e. mineral soil or swamp, volume of the forest growing stock, main tree species, development class, nutrient content of soil, and drainage.

Field material

The project comprises some partial objectives which has resulted in four kinds of field data.

1) Variable plots (1 tree tallied = 1 m^2/ha) which are drawn by restricted random sampling from the homogeneous groups based on photo interpretation (concentration areas 1, 3, 5, and 7, see Fig. 3). The number of these plots is about 280.

2) Variable plots as above taken systematically from the concentration areas 2, 4, 6, and 8 (Fig. 4). The number of these plots is also about 280.

3) Extra plots as above taken in arbitrarily way from all the 8 concentration areas. The main purpose of these plots was to enhance to study the accuracy of the inventory methods. The number of those plots was about 500.

4) The plots dedicated only for the study of correlation between tone values measured from satellite pictures and the stand characteristics. The plots were 60 x 60 metres in size and their measurements were made by using 9 point sampling where each point was a centrum for a variable plot in which one tree tallied represented 4 m^2/ha (Fig. 5). The number of the plots is about 1000.

Grey tones

The diapositives 1:1000000 of ERTS imagery were enlarged and rectified to 1:400000 and supplied by a grid where one square represented 4 x 4 km in fhe field. The grey tones are then measured by microdensitometer along the lines the width of which is 60 metres. A point read from the microdensitometer curve refers to a square of 60 x 60 metres. In addition, similar lines are measured 60 metres to both sides from the original (center) line. However, the measuring procedure is still under experimentation.

Present stage of investigation

The material collected in the field is arranged to be handled by computer. Some test material has been calculated by hand work. The first impression is that the radiometric accuracy of ERTS imagery is not good enough to give tone values for squares of 60 x 60 m. One of the study tasks then is to find out if it is possible by increasing the plot size to increase the correlation between tone values and stand characteristics to practicable level. This approach might be possible by extending the plot characteristics measured in the field to large stands by using aerial photographs and by determining the respective tone values directly for the larger area units.

Because of the analytical nature of the problemacy no recommendations are feasible in this stage of the study. Accordingly no articles or papers have been published during thé reporting periods.

Helsinki, 1973-10-05

Kullervo Kuusela

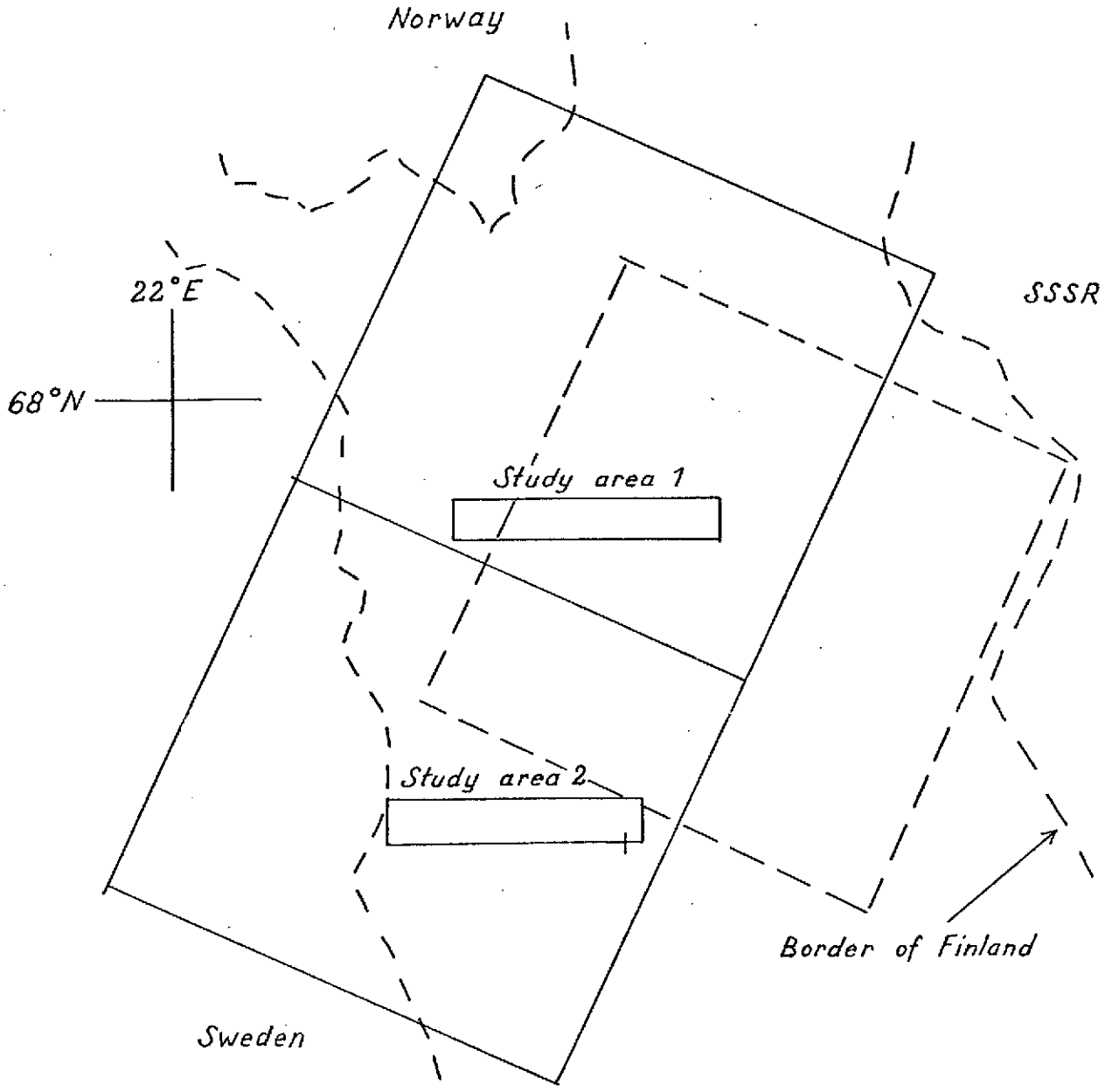

Fig. 1. Location of the ERTS imagery (Aug. 31. 1972, solid line), originally suggested area (square with broken line), and the study areas of more intensive study (rectangles) with solid line).

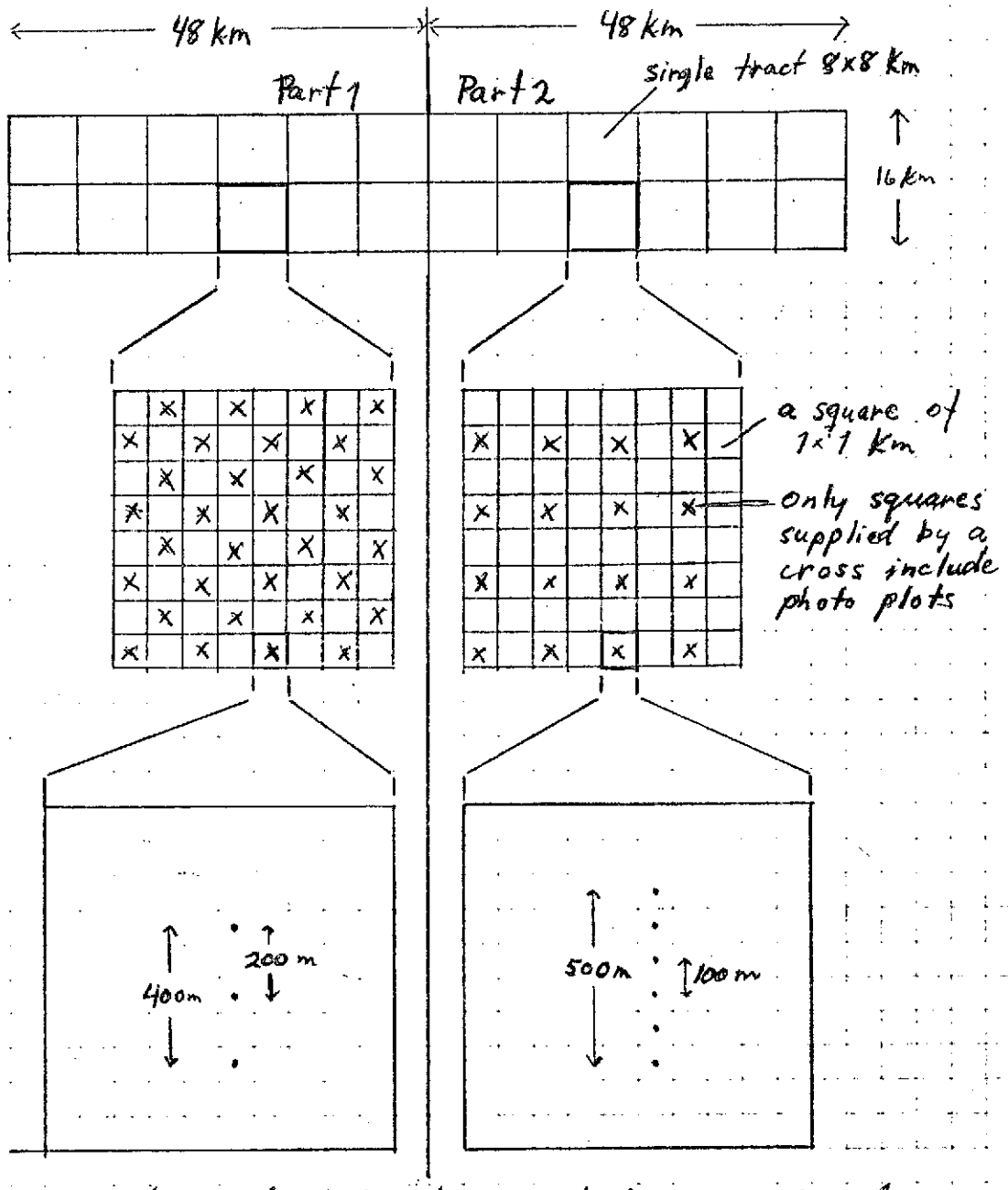

Fig. 2. Location of photo plots in study areas 1 and 2

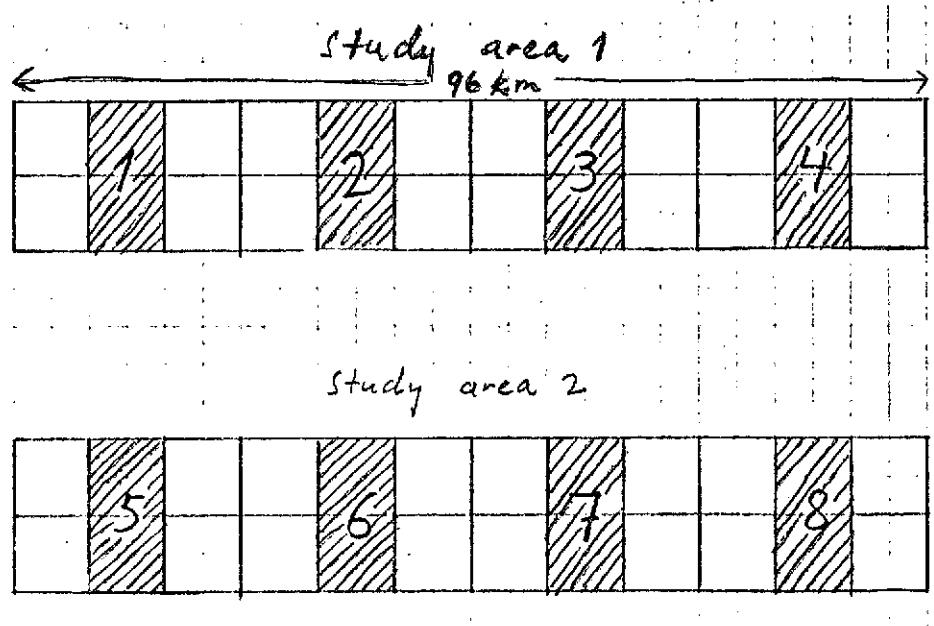

Fig. 3. Concentration areas for field material (shadowed areas)

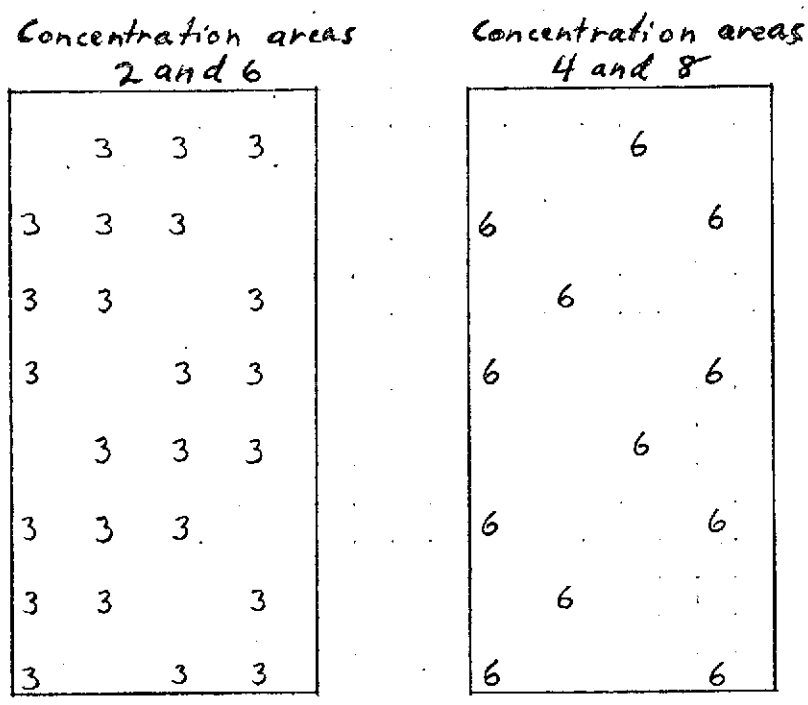

Fig. 4. Design of systematic sampling. The figures refer to the squares (1 x 1 km) and the number of field plots per square

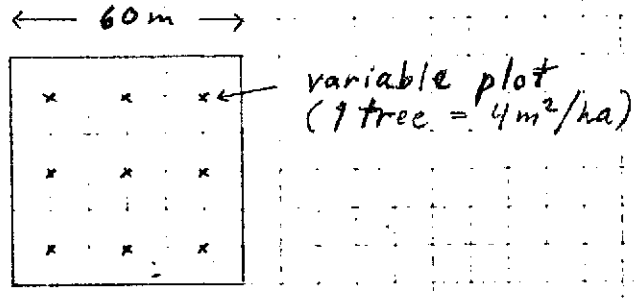

Fig. 5. Square plot sampled by 9 variable plots